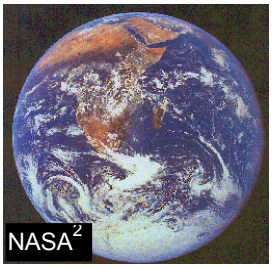
United States Department of Agriculture
Agricultural Research Service

WATERSHED SCIENCE **FACT SHEET**



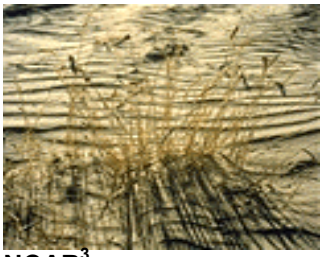
Understanding the Global Water Cycle

The Key to Reducing Weather and Climate Uncertainties for American Agriculture

American agriculture and global climate are inextricably linked. Understanding how a change in the Earth's climate would affect water resources management strategies at the farm, ranch, rural community, and regional river-basin scale is an important mission for the Agricultural Research Service.

Although there is nothing new about our planet experiencing climate changes, scientists worldwide are increasingly concerned with potential temperature increases and changes in precipitation patterns. These are known collectively as global climate change, and they might occur in part because of the rise of greenhouse gas concentrations in the Earth's atmosphere. Scientists think this is occurring as a result of human activities.

The need for preparedness. Fine-tuning of agriculture practices to the environment has allowed the United States to provide the best quality and diversity of food ever known, and at reasonable prices. However, this bounty could be severely threatened if rising temperatures and altered rainfall patterns catch the Nation unprepared.



NCAR[3]

The drought of 1988 was the most costly natural disaster in U.S. history, with losses reaching more than $39 billion. Economic damages from the 1993 Midwest flood were estimated by FEMA[1] to have exceeded $16 billion.

Climate change could increase the frequency and severity of adverse weather, but the vulnerabilities probably would vary from region to region. Many regions would be likely to experience increased droughts and floods.

NCAR[3]

The Pacific Northwest could see changes in snowpack accumulations and the timing of snowmelt. The National Research Council has identified major challenges associated with measuring the variability of climate and weather and its relation to landscape characteristics and agricultural ecosystems. Much remains to be learned about questions concerning changes in climate and precipitation patterns that are especially important to agriculture.

The USDA Watershed Program provides information essential to coping with weather and climate changes. Assessing the impacts of variable weather on rural communities and agricultural producers demands the expansion and long-term operation of the network of intensively instrumented USDA watersheds. Their unique features provide scientists with:

- Ready access to long-term data records to characterize the variability of water cycle components.
- Testing facilities for new and developing technologies for measuring and evaluating data related to the water cycle.
- Development of modeling strategies that will reproduce observed variability and help discriminate natural and human-caused sources of variability.
- Opportunities to improve predictive capabilities at annual, seasonal, and shorter time scales that are needed to test strategies to mitigate the effect of weather extremes.

This fact sheet was produced by the ARS National Program on Water Quality and Management. For additional information call (301) 504-7987

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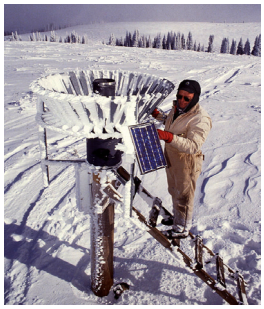
[1] FEMA: Federal Emergency Management Agency
[2] NASA: National Aeronautics & Space Administration
[3] NCAR: National Center for Atmospheric Research
[4] NRCS: USDA Natural Resources Conservation Service

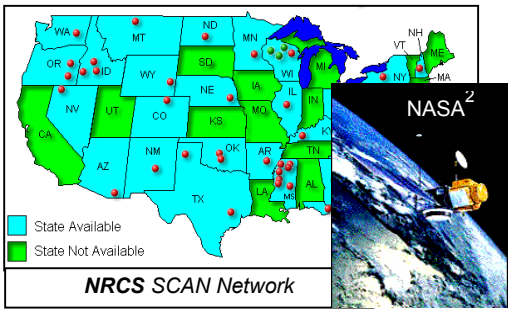
Preparing Agriculture for Changing Water Resources

The USDA Watershed Program Is Ready To Meet the Challenge



Estimating Climate Impact on Snowpacks. Even a modest warming or cooling of our climate may change the amount and timing of snowmelt and runoff in western basins. Melting snowpacks of high-mountain watersheds in the western United States provide 50 to 80 percent of the West's water for farms, ranches, and other downstream destinations. Estimating the volume of water contained in snowpack is vital to forecasting how much water will be available for agriculture and other uses. Global warming would cause snowmelt and runoff to start–and peak–earlier in the year. The greatest volume of runoff could occur not in May or June but instead in March or April. That means western farmers of the next century may have to make new choices when deciding what kinds of crops to plant. What's more, a warmer climate may also cause less snow to accumulate and yield less water at certain elevations.

Understanding the Role of Soil and Vegetation on the Global Water Cycle. ARS scientists organized and led a large scale study entitled *Southern Great Plains 97* on the ARS Little Washita River experimental watershed in Oklahoma. The project integrated the collaboration of scientists from several ARS locations, universities, state and federal agencies. The project mission: to track soil moisture changes over a 24x150 mile area extending from Kansas, through Oklahoma and Texas using satellites, airplanes, and sensors that are prototypes for future satellite remote-sensing platforms. Data from this and similar large scale experiments would lead to more accurate water resources models and better irrigation planning.



***NRCS** SCAN Network*

Monitoring the Feedback Between Land Surface Utilization and the Earth Atmosphere. Soil moisture and temperature, is the fundamental switch that controls the portion of rainfall that percolates, runs off, or evaporates from the land feeding heat to the atmosphere. NRCS[4] is partnering with ARS, universities, and other agencies to maintain and operate the Soil Climate Analysis Network (SCAN) that tracks shifts in soil moisture and temperature over the continental U.S. This critical information is needed to track shifts in water resources, for calibration of satellite sensors, as input to global climate models, and to scale down water cycle processes from the regional to the farm level.

Estimating the Effect of Global Changes on Regional and Local Water Impacts. The ENSO (El Niño Southern Oscillation) cycle refers to a vast coupled ocean-atmosphere perturbation centered in and over the tropical Pacific that causes severe changes in atmospheric temperatures and rainfall patterns. The scale of these fluctuations is quite vast, with the changes in sea-surface temperatures oftentimes spanning a distance of more than one-quarter the circumference of the globe. Current weather generation and water resources models cannot quantify the feedback from those changes. The USDA Watershed Program has enabled scientists to implement a research initiative devoted to improving scientific understanding of the water cycle over a broad range of spatial scales. The goal is to achieve a clear description of global change feedback at a given scale, be it a farm, watershed, or region, and how they affect water resources at these scales.

ENSO-Sea Surface Temper.